Distinguished Scientist Seminar Series

Thursday
May 14, 2015
9:30 a.m. - 11:00 am
Building 74, Room 104
Lawrence Berkeley National Laboratory
Host: Jens Birkholzer

Exploring Activated Faults Hydromechanical Processes from Semi-Controlled Field Experiments

Yves Guglielmi

Marseille University, France

Yves Guglielmi is professor at Marseille University in France. His research is focused on the in-situ study of the dynamic hydromechanical processes in fractures and fault zones close to a fluid source, mainly at the scale away from the well (meter to hectometer scale) in porous and unporous rocks.

Abstract

The appreciation of the sensitivity of fractures and fault zones to fluid-induced-deformations in the subsurface is a key question in predicting the reservoir/caprock system integrity around fluid manipulations with applications to reservoir leakage and induced seismicity. It is also a question of interest in understanding earthquakes source, and recently the hydraulic behavior of clay faults under a potential reactivation around nuclear underground depository sites. Fault and fractures dynamics studies face two key problems (1) the up-scaling of laboratory determined properties and constitutive laws to the reservoir scale which is not straightforward when considering faults and fractures heterogeneities, (2) the difficulties to control both the induced seismicity and the stimulated zone geometry when a fault is reactivated. Using instruments dedicated to measuring coupled pore pressures and deformations downhole, we conducted field academic experiments to characterize fractures and fault zones hydromechanical properties as a function of their multi-scale architecture, and to monitor their dynamic behavior during the earthquake nucleation process. We show experiments on reservoir or cover rocks analogues in underground research laboratories where experimental conditions can be optimized. Key result of these experiments is to highlight how important the aseismic fault activation is compared to the induced seismicity. We show that about 80% of the fault kinematic moment is aseismic and discuss the complex associated fault friction coefficient variations. We identify that the slip stability and the slip velocity are mainly controlled by the rate of the permeability/porosity increase, and discuss the conditions for slip nucleation leading to seismic instability.

Distinguished Scientist Seminar Series
Earth and Environmental Sciences Area
Lawrence Berkeley National Laboratory
MS74R316C
1 Cyclotron Rd.
Berkeley, CA 94720

Contact: shefty@lbl.gov
Phone: 510.486.4271
Fax: 510.486.5686
Web: http://esd.lbl.gov/newsandevents/dsss

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